Docket No. 2003-059-TAP

# MULTI-DIRECTIONAL CARTRIDGE MEMORY ANTENNA DESIGNS

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention:

The present invention relates generally to an improved contactless tape cartridge memory device. In particular, the present invention relates to a method and system for using an RFID memory device having a bi-axial reader antenna design in a tape cartridge to communicate with a tape drive.

### 2. Background of the Invention:

Radio frequency identification (RFID) systems provide a wireless means of communication between tagged objects and readers. RFID offers the means to identify, locate, and track objects using a radio frequency (RF) transmission. An RFID tag offers benefits over using a barcode, for the RFID tags can be read at greater distances, in any orientation, and through intervening objects, as well as offering the means to update and store information on the tag itself.

A typical RFID system includes a reader, a tag or transponder, and a data processing system. In a passive RFID system, the RFID tag does not have a power source. Instead, the reader is used to activate the passive tag by emitting a radio frequency (RF) signal via an antenna connected to the reader. The reader antenna may be of various size and structure, depending upon the communication distance required for the particular

system. When the tag is in range of the reader antenna's magnetic field, the reader antenna transmits energy to the tag, which returns its on-chip data to the reader via a backscattering modulation.

The tag is typically mounted onto a moveable object. The tag includes an integrated circuit (IC) and an antenna assembly. The antenna captures and transmits signals to and from the reader.

RFID systems may be used for various applications, including identifying tape cartridge information. Tape cartridges have proven to be an efficient and effective medium for data storage, including backing up data from primary storage devices and acting as primary storage devices for infrequently accessed data. In a conventional tape library employing an RFID system, the reader is located within the tape drive. As the tape cartridge is inserted into the tape drive, the reader supplies power to the memory device within the tape cartridge and may receive data stored within the cartridge memory device.

However, it would be beneficial to be able to access the RFID memory device in the tape cartridge while the tape cartridge is inserted into the tape drive. Consequently, it would be advantageous to have a contactless tape cartridge memory device which is accessible from multiple surfaces of the cartridge. In particular, it would be advantageous to have a contactless tape cartridge memory device accessible from the front of the cartridge by a hand held reader and from the side or the bottom of a cartridge by the tape drive.

## SUMMARY OF THE INVENTION

The present invention provides a method and system for transmitting tape cartridge information using a bi-axial tape cartridge antenna design. A contactless tape cartridge memory device is provided in which the memory device is accessible from multiple surfaces of the cartridge. For example, a hand held reader may access the memory device from the front of the cartridge while the tape drive can access the memory device from the side or the bottom of the cartridge. As a result, the memory device in the tape cartridge may be read when the cartridge is being inserted into the tape drive as well as while the cartridge is stored within the tape drive.

In the preferred embodiment, the present invention includes a memory device surrounded by a single flexible antenna. The flexible antenna may be bent to fit in the corner of the tape cartridge, so that the tape cartridge memory device is accessible from at least two surfaces of the cartridge.

An alternative embodiment of the present invention includes attaching two separate antennas to the tape cartridge memory device. Each antenna would be orthogonal to the other, thus providing a parallel antenna surface to two locations on tape cartridge.

A further alternative embodiment of the present invention includes imbedding the antenna into the cartridge molding, making the antenna and the cartridge the same component. Since the antenna is imbedded within the cartridge, concerns regarding the placement of the

component or whether the antenna component might get loose within the cartridge, thereby making the antenna unusable for its desired purpose, would no longer be relevant. In addition, communication distance may be optimized using an imbedded antenna since the distance between the tag antenna and the reader antenna would be diminished.

## BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

**Figure 1** depicts a top perspective view of a tape cartridge in accordance with a preferred embodiment of the present invention;

**Figure 2** depicts a side perspective view of a tape cartridge in accordance with a preferred embodiment of the present invention;

**Figures 3A-3C** are examples of a tape cartridge memory device in accordance with a preferred embodiment of the present invention;

**Figure 4** depicts a tape cartridge and reader system in accordance with a preferred embodiment of the present invention;

**Figure 5** is a flowchart depicting a contactless data transmission process in accordance with a preferred embodiment of the present invention;

**Figures 6A-6C** are examples of a tape cartridge memory device in accordance with an alternative embodiment of the present invention;

**Figure 7** depicts a top perspective view of a tape cartridge in accordance with an alternative embodiment of the present invention;

**Figure 8** depicts a side perspective view of a tape cartridge in accordance with an alternative embodiment of the present invention; and

**Figure 9** depicts a diagram of a tape cartridge with an imbedded antenna in accordance with an alternative embodiment of the present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention provides a method and system for transmitting tape cartridge information using a bi-axial tape cartridge antenna design. The present invention may be implemented in any tape library system. A contactless tape cartridge memory device is provided in which the memory device is accessible from multiple surfaces of the cartridge. In the preferred embodiment, the present invention includes a tape cartridge memory device surrounded by a single flexible antenna. The antenna may be bent to fit within the corner of the tape cartridge, thus providing a parallel antenna surface to two locations on the cartridge, such as the front of the cartridge and the side or bottom of the cartridge.

**Figure 1** shows a tape cartridge in accordance with a preferred embodiment of the present invention. In this embodiment, the tape cartridge memory device/antenna is curved to fit within the corner of the tape cartridge. Tape cartridge **102** includes a memory device **106** connected to and surrounded by antenna **108**. Memory device **106** and antenna **108** are connected to form an RFID tag **110**. Memory device **106** may be a conventional integrated circuit, or any other memory storage device capable of receiving electronic information. Memory device **106** contains information related to tape cartridge **102**, including cartridge identification information, performance and manufacturing data, and file location information.

Antenna **108** is preferably a helical antenna surrounding memory device **106**. Antenna **108** captures and transmits signals to and from a reader. As shown in **Figures 1** and **2**, antenna **108**, **208** may be bent in a manner so as to position RFID tag **110** to fit within a corner of tape cartridge **102**. Although RFID tag **110** is set in a corner in the front of tape cartridge **102**, RFID tag **110** may be located in any corner of tape cartridge **102**, depending upon the desired location of access. Flexible antenna **108** provides a parallel antenna surface to two locations on the cartridge. For example, in **Figure 2**, memory device **206** may be accessible from front **204** of cartridge by a hand held reader, as well as from side or bottom **212** of cartridge **202** by the tape drive.

An example of an RFID tag having a flexible antenna connected to and surrounding a memory device is shown in **Figures 3A-C**, with illustrations of the RFID tag shown via top view **3A**, side view **3B**, and front view **3C**.

Turning now to **Figure 4**, a tape cartridge and reader system in accordance with a preferred embodiment of the present invention is shown. Reader **402** is used to activate the passive tag via a radio frequency (RF) signal. Reader **402** includes an IC chip **404**, oscillator **406** for generating and amplifying signals, and a reader antenna **408**. Power is provided to reader IC chip **404** and to oscillator **406**.

An RF signal may be continuously transmitted from reader antenna **408** located in, for example, a tape drive or a hand held device. When memory device **414** is in range of the reader's magnetic field, the RF field passes

through antenna coil **416**. Consequently, inductive coupling occurs between reader **402** and cartridge memory device **414**, whereby cartridge memory device **414** effectively downloads the reader signal. The transmitted energy is used to power memory device **414**. Once the signal is loaded down, reader IC chip **404** detects the presence of memory device **414** as a decrease in amplitude.

**Figure 5** is a flowchart depicting a contactless data transmission process in accordance with a preferred embodiment of the present invention. The process begins with the tape drive providing power to the reader device and to the oscillator (step **502**). When the passive cartridge device is in close proximity to the energized reader antenna, inductive coupling occurs (step **504**). In response, the passive cartridge device effectively loads down the reader signal (step **506**). Once the signal is loaded down the reader IC detects the presence of the passive cartridge device as a decrease in amplitude (step **508**). At this point the device is ready to receive instructions from the reader (step **510**).

As stated before, the present invention provides a mechanism for transmitting tape cartridge information using a bi-axial tape cartridge antenna design. **Figures 1-3** illustrate an antenna design comprising a single data transmitted antenna.

**Figures 6A-C** shows an alternative embodiment of antenna **108**, with illustrations of the RFID tag shown via top view **6A**, side view **6B**, and front view **6C**. Top view **602** of the RFID tag depicts memory device **608** connected to two antennas **610** and **612**. Second antenna **612** is added to

the RFID tag at a right angle to first antenna **610**. Antennas **610** and **612** may be flexible, similar to antenna **108** in **Figure 1**, or rigid antennas may be used. In either case, positioning second antenna **612** at a right angle to first antenna **610** provides a parallel antenna surface to two locations on tape cartridge.

**Figures 7 and 8** illustrate, respectively, a top and side perspective view of a tape cartridge in accordance with the embodiment of the present invention as described in **Figures 6A-C**. Memory device **706**, **806** may be accessible from front **804** of cartridge **802** by a hand held reader, as well as from side or bottom **812** of cartridge **802** by a tape drive. Antennas **808** and **810** are connected to memory device **806** and positioned within a corner of tape cartridge **802**.

Turning now to **Figure 9**, a third embodiment of the present invention is shown. **Figure 9** depicts a memory device connected to an antenna which is imbedded into the tape cartridge molding. Imbedded RFID tag comprises a memory device **904** and an imbedded antenna **906** that is molded into two surfaces of tape cartridge **900**. Memory device **904** may be set up or soldered against an inside surface of cartridge **900**. Memory device **904** may also be connected to imbedded antenna **906**. For example, imbedded antenna **906** may contain a connection point **908** for memory device **904**. Memory device **904** may then be connected to imbedded antenna **906**, for example, via an exposed wire coming out of imbedded antenna **906**.

The positioning of imbedded antenna **906** may be similar to the positioning of flexible antenna **108** as

described in **Figure 1**. In other words, imbedded antenna **906** may be positioned to provide a parallel antenna surface to two locations on cartridge **900**. For example, memory device **904** may be accessible from front **910** of cartridge by a hand held reader, as well as from side or bottom **912** of cartridge **900** by the tape drive. In the preferred embodiment, imbedded antenna **906** is a coil antenna, although other antenna configurations may be implemented.

Imbedding the antenna into the cartridge molding maximizes efficiency of the antenna to reader transmission. Communication distance between the antenna and the reader is optimized, since the tag antenna and reader antenna can make closer contact. In addition, the antenna component of the RFID tag would no longer be a separate component from cartridge. Furthermore, placement of the antenna component would no longer be an issue, since the antenna would be imbedded in the cartridge. In other words, the antenna placement decision is performed during cartridge manufacturing, rather than when the memory device is set into the cartridge.

Thus, the present invention provides a method and system for transmitting tape cartridge information using a bi-axial tape cartridge antenna design. A contactless tape cartridge memory device is provided in which the memory device is accessible from multiple surfaces of the cartridge. For example, a hand held reader may access the memory device from the front of the cartridge while the tape drive can access the memory device from the side or the bottom of the cartridge. As a result, the memory

device in the tape cartridge may be read when the cartridge is being inserted into the tape drive as well as while the cartridge is stored within the tape drive.

The advantages of the present invention should be apparent in view of the detailed description above. The present invention offers a bi-axial tape cartridge antenna design which provides a parallel antenna surface to at least two locations on tape cartridge.

The description of the present invention has been presented for purposes of illustration and description, and is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. The embodiment was chosen and described in order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.